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CHARACTERISTICS FOR EVALUATING TECHNOLOGY READINESS LEVELS FOR SPECIFIC PROPOSED INSTRUMENTS

TRL 1: Basic principles observed and reported

- Very little investment in proposed instrument
- Scientific papers written on basic principles
- Essentially no experimental studies
- No previous flight experience with the proposed instrument
- No Phase A studies
- No definition approach selected for any flight application

TRL 2: Technology concept and/or application formulated

- Some Phase A studies conducted for the proposed instrument in a flight application
- Important trades have been studied and documented
- Limited experimental studies
- No previous flight experience with the proposed instrument

TRL 3: Analytical and experimental critical function and/or characteristic proof of concept

- An integrated Phase A study was completed for proposed instrument in a flight application
- Analytical and experimental studies conducted that demonstrate viability of critical functions and provide proof of concept; studies may be Supporting Research Technology (SRT) studies and Advanced Research Technology (ART) studies
- Initial weight and power allocations at instrument level have been made
- No previous flight experience

TRL 4: Component and/or breadboard validation in laboratory environment

- Key instrument components and/or breadboards of the proposed instrument have been validated in laboratory environment, which may have included balloon or suborbital flights
- Instrument definition study (Phase B) has been completed
- Key trade studies have been conducted
- Detailed weight and power requirements are known
- There is a first cut at weight and design margins

TRL 5: Component and/or breadboard validation in relevant environment

- Key instrument components and/or breadboards of the proposed instrument have been validated by orbital flight
- Instrument definition study (Phase B) has been completed
- Key trade studies have been conducted
- Detailed weight and power requirements are known
- Principal Investigator is in a position to establish firm weight and design margins and schedule

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CHARACTERISTICS FOR EVALUATING TECHNOLOGY READINESS LEVELS FOR SPECIFIC PROPOSED INSTRUMENTS (continued)

TRL 6: System/subsystem model or prototype demonstration in a relevant environment (ground or space)

- Subsystem prototypes or models of the proposed instrument have been successfully tested under space conditions in orbital flight
- Proposed instrument will require substantial modifications for proposed mission

TRL 7: System prototype demonstration in a space environment

- Prototype of the proposed instrument has been successfully tested in a recent (i.e., within 3 years) flight demonstration in orbital flight
- Mission-like flight functions conducted in flight demonstration
- Proposed instrument will require minor modifications for proposed mission

TRL 8: Actual system completed and “flight qualified” through test demonstration (ground and space)

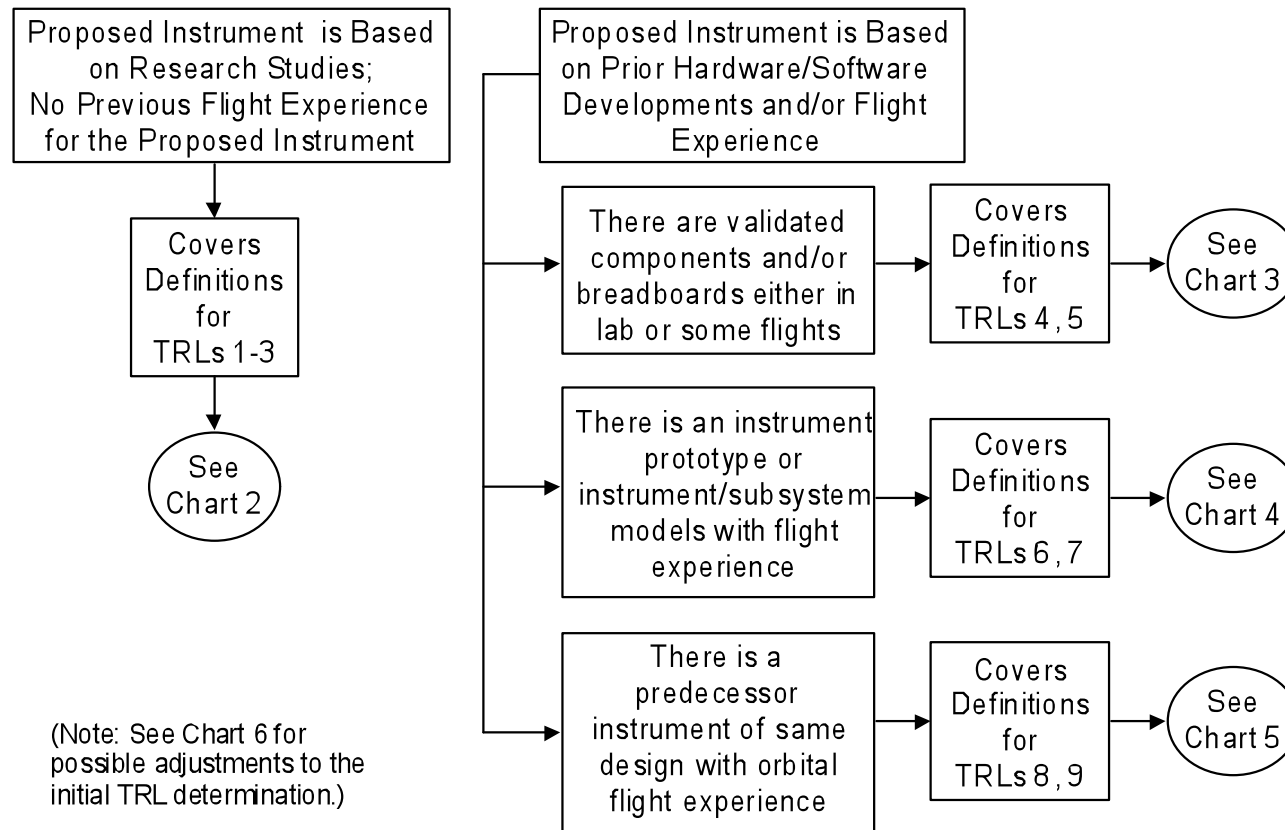
- Predecessor instrument has been successfully tested in a recent (i.e., within 3 years) flight demonstration in orbital flight as well as successful ground end-to-end tests
- Mission-like data obtained in previous flight
- Proposed instrument will have no more than very minor modifications

TRL 9: Actual system “flight proven” through successful mission operations

- Predecessor instrument has been operationally proven in a recent (i.e., within 3 years) full space mission (not suborbital, balloon or test demonstration) that was a similar mission to the one planned for the proposed instrument
- Actual mission-required data obtained in previous flight
- Proposed instrument is a follow-on to the predecessor instrument and has essentially the same design or only slight structural modifications
- Proposed instrument will not have improvements in sensors
- Proposed instrument will not have any changes in calibration techniques
- Proposed mission changes will be very minor for science objectives and orbit parameters

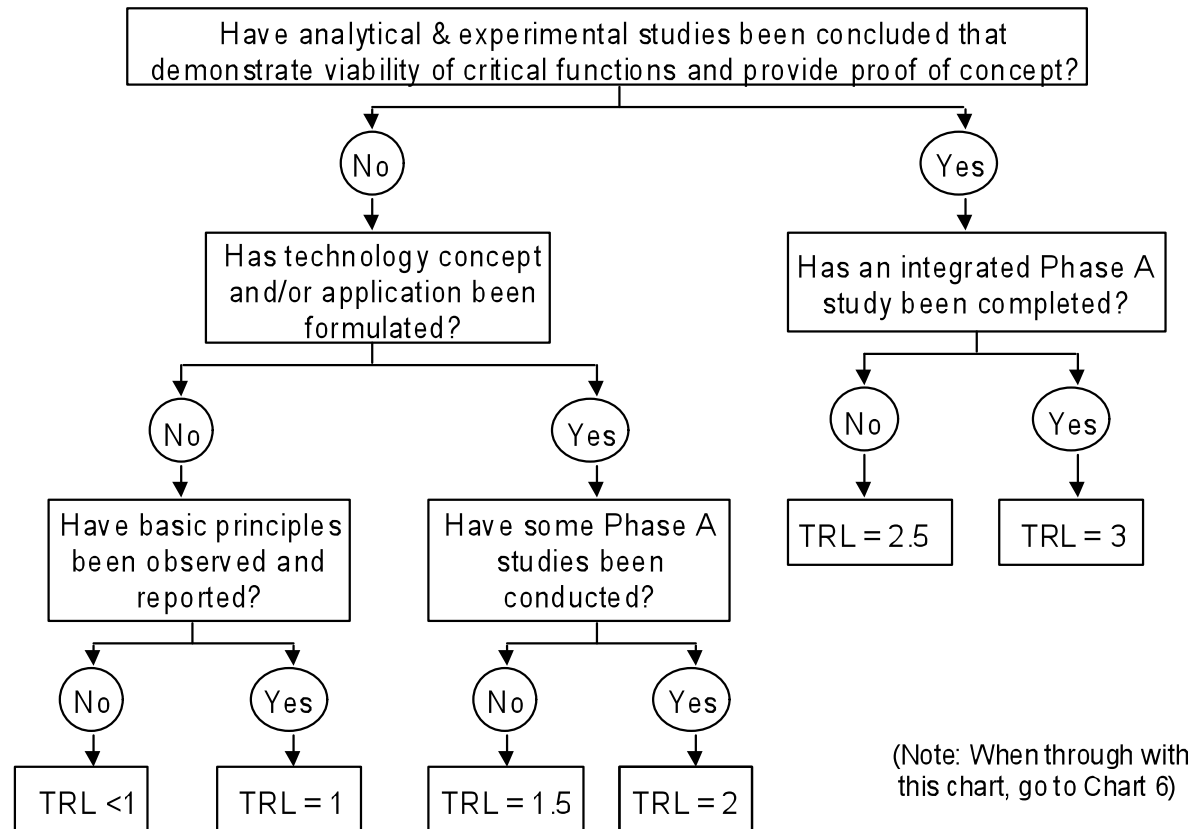
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Chart 1: Guide to Initial TRL Determination (Before Adjustments) for Proposed Instrument



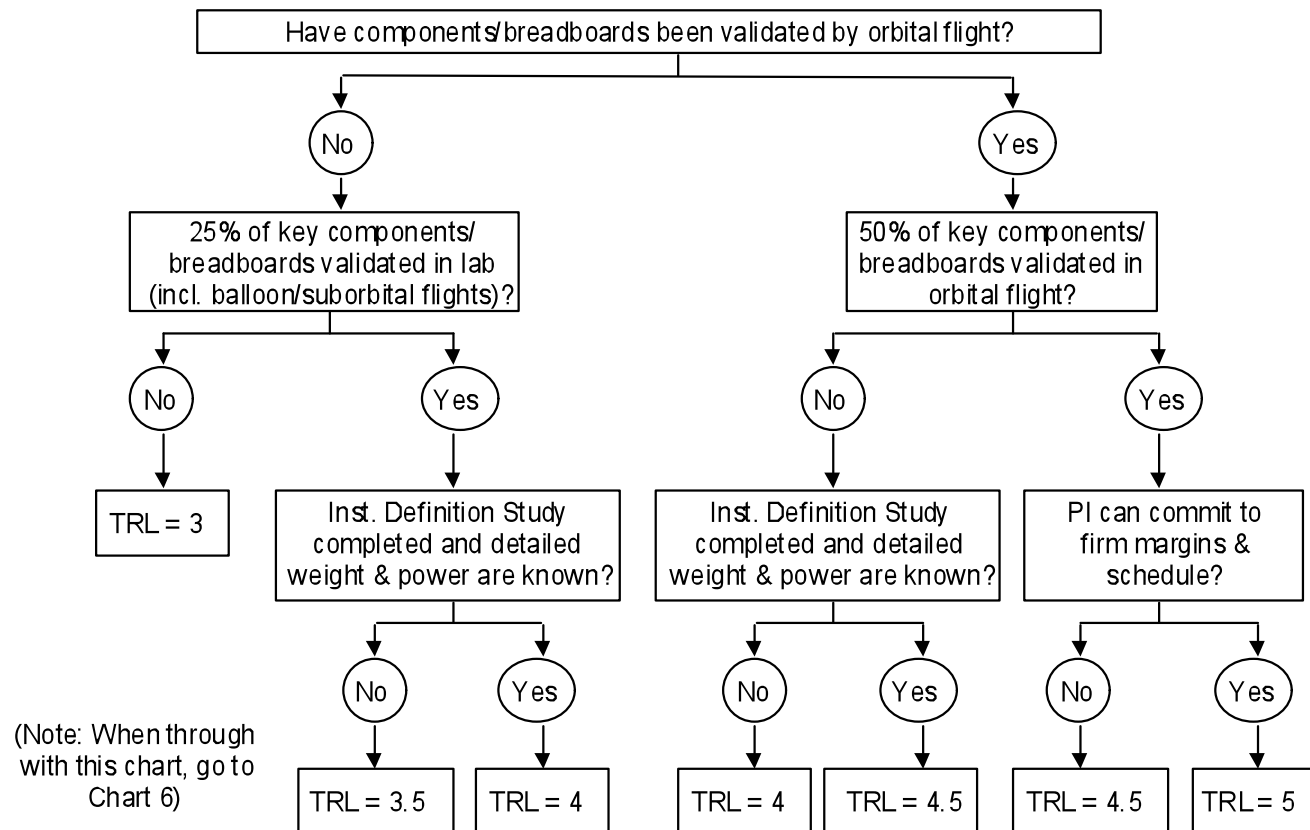
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Chart 2: Proposed Instrument Based on Research Studies --
No Previous Flight Experience for Proposed Instrument



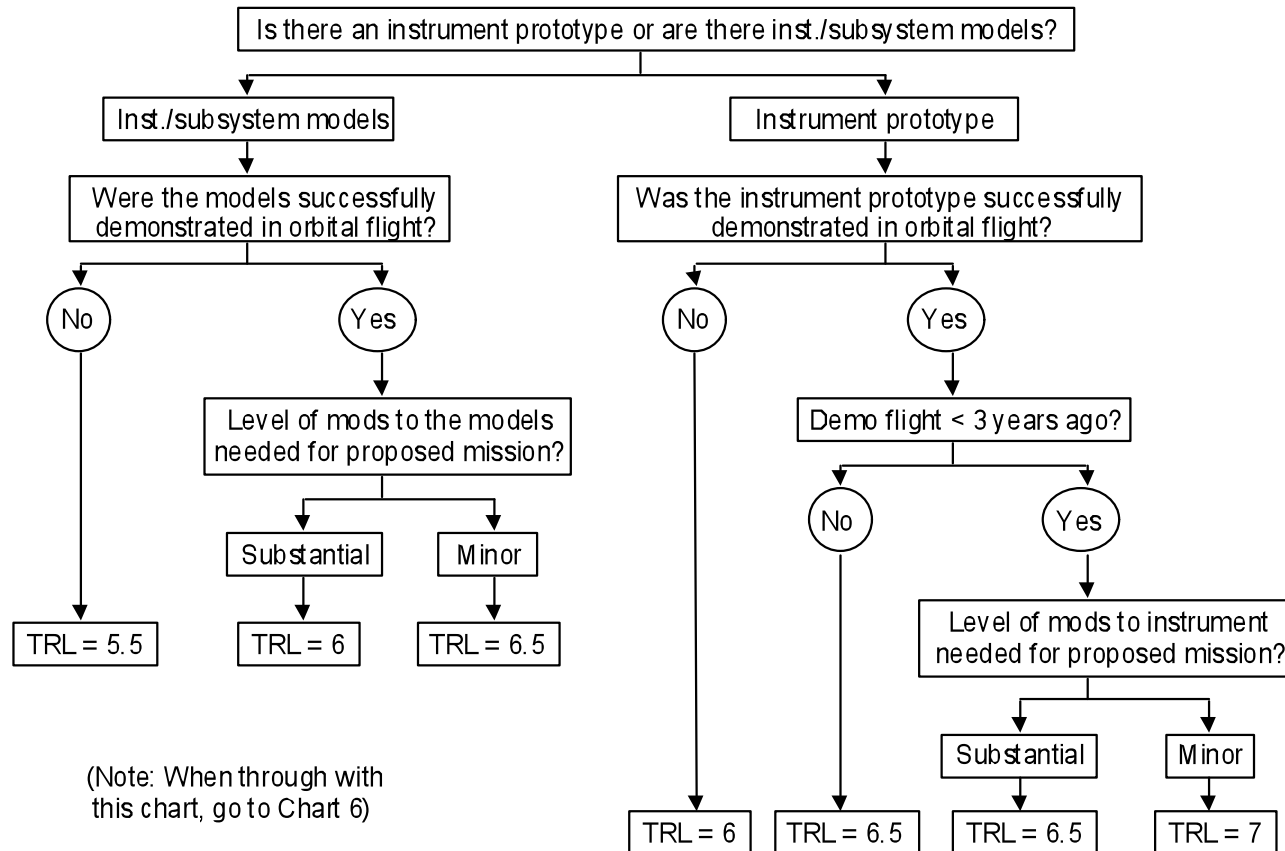
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Chart 3: Proposed Instrument Has Validated Components and/or Breadboards



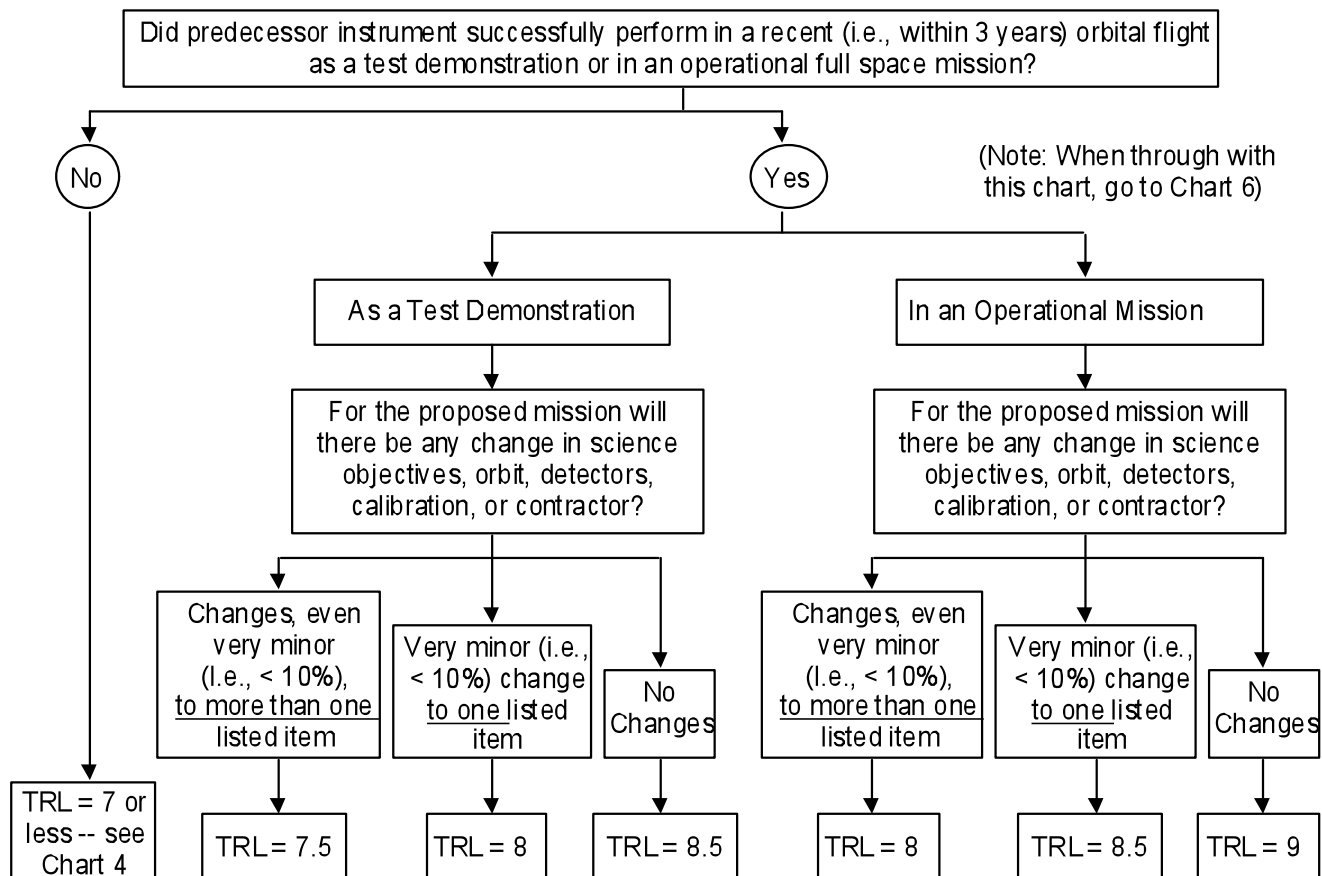
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Chart 4: There is an Instrument Prototype or are Instrument/Subsystem Models for the Proposed Instrument



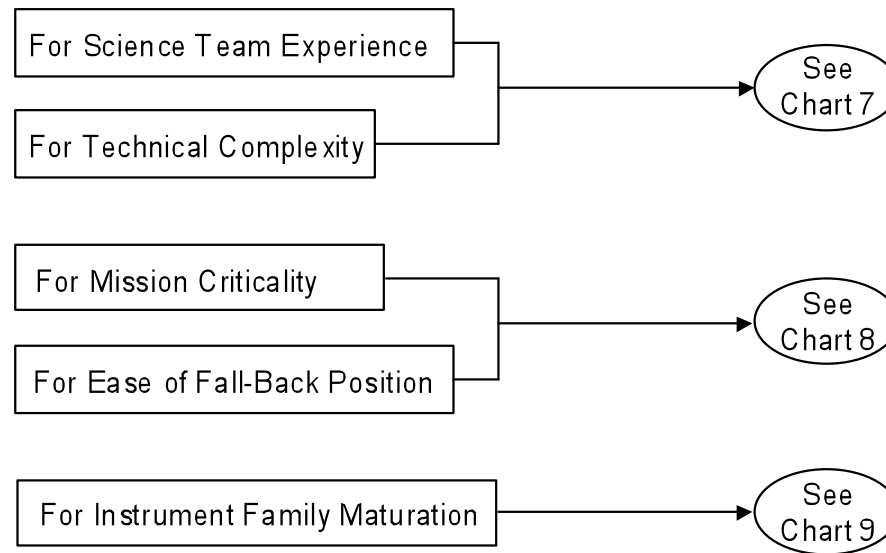
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Chart 5: Proposed Instrument Has Predecessor of Same Design



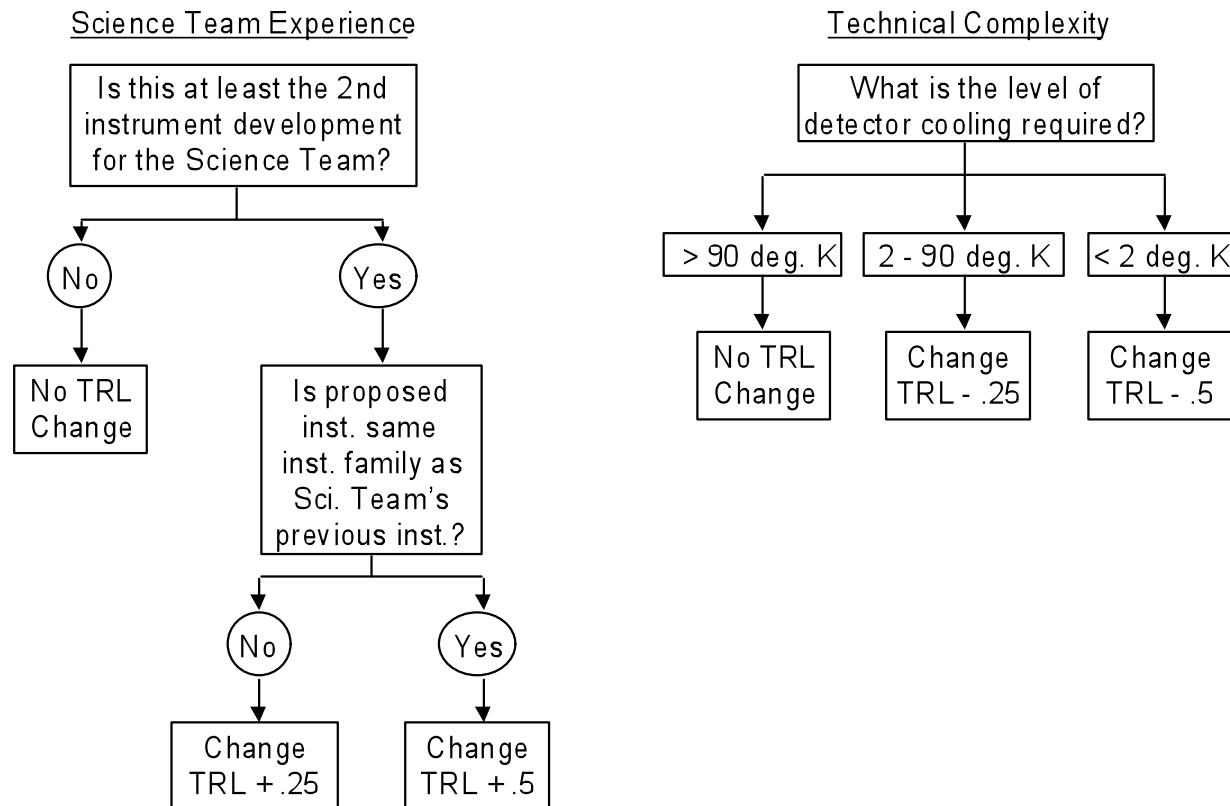
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Chart 6: Guide to TRL Adjustments



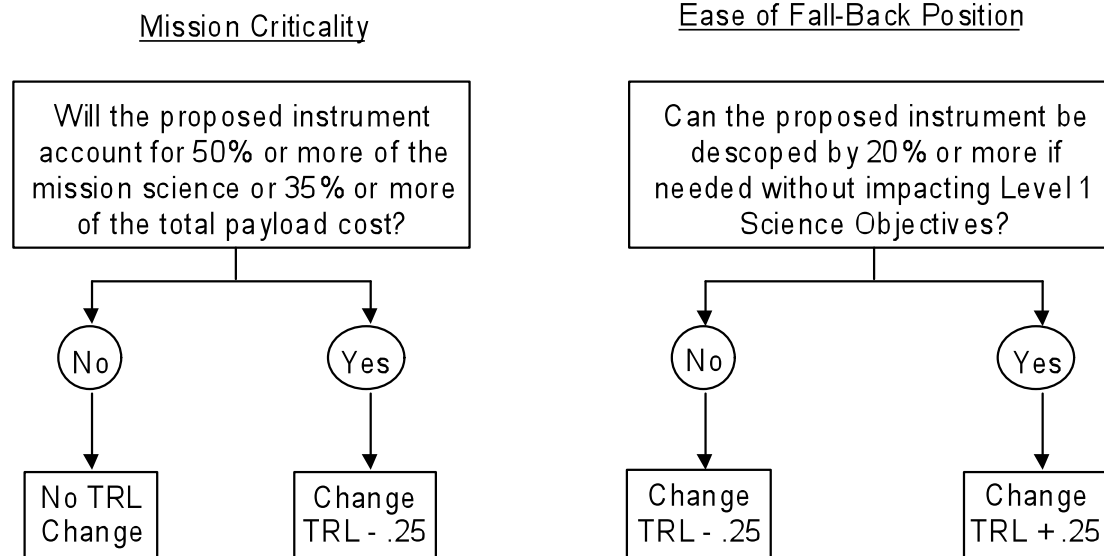
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Chart 7: TRL Adjustments for Science Team Experience and Technical Complexity



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Chart 8: TRL Adjustments for Mission Criticality and Ease of Fall-Back Position



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Chart 9: TRL Adjustments for Instrument Family Maturation

